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NRO REVIEW COMPLETED

23 APR 1969

MEMORANDUM FOR THE RECORD

SUBJECT: U-2R LOX System Meeting, 18 April 1969

1. A meeting was held at Lockheed Aircraft Corporation (LAC), Burbank, California, on 18 April 1969 to discuss a proposed U-2R LOX System design concept, testing conducted to date, and a recommended course of action. The reason for this latest in a long series of meetings and/or discussions is apparent if the record of meetings, memoranda, and messages on the subject are reviewed. The record describes the historical aspects of the U-2R LOX System. Attendees at the 18 April 1969 Meeting were:

Headquarters

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LAC

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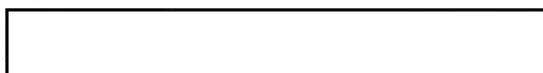
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ARO



Detachment G



2. A historical review of the LOX system and current status was not presented since most, if not all, participants were intimately familiar with this aspect. Instead, [redacted] presented a concise and consolidated (i.e., joint LAC and ARO) position on the course of action required to improve the U-2R LOX system to the point that it would in no way prevent [redacted] from being utilized to the maximum limits of its design specification. It was refreshing, indeed, to hear a presentation that gave credit where it was due, that avoided cliches and innuendos, that portrayed a feeling of mutual trust and confidence, and which conveyed to the customer that things were back to normal and tracking to the benefit of the pilot's well-being and mission accomplishment.

3. The specific conclusions and recommendations made and accepted were as follows:

a. The ARO PM-24500-3 LOX converter design/system and the LAC RQ-1020-100 were tested under identical bench test conditions with no significant differences in results. Two design features (i.e., an orifice and filter screen) of the ARO system that differed from the LAC system and which were not required for the intended application, were, by mutual and unanimous agreement, eliminated from further consideration. Likewise, the LAC system utilized a modified pressure opening/pressure closing valve (with the opening function eliminated) to accomplish the same purpose as the ARO single, new pressure control valve. The later valve was determined to be more desirable from a cost maintenance and replacement point of view, as well as from a possible materials, fatigue, service-life aspect.

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b. Considering all aspects, including the LAC statement that their Company was not, in fact, in the oxygen equipment manufacturing business, it was recommended and accepted that, following a design/hardware flight test confirmation period, the system to be used in the U-2R would be the ARO PM-24500-3, and that LAC will retain, as with the original PM-24500-1 system, the responsibility for the system by performing all receiving/quality control/functional testing of the ARO system prior to issue to the field

c. The in-flight confirmation of design and hardware will consist of installing, after removal of the orifice and screen (referred to in para. 3a. above) one each of the two ARO PM-24500-3 systems (SN 301 and 302 functionally tested by LAC, in aircraft numbers 054 and 055. After a total of approximately five total successful flights with one new converter installed (along with a LAC-RQ-1020 converter), one or both aircraft will then be converted to both converters of the new design. After a total of 50 hours of successful in-flight use, the entire U-2R fleet (both customers) will be retrofitted with the new design converter system.

d. Aircraft 057 and 058 at Detachment H will receive first priority for retrofit, aircraft at SAC's OL-19 (and OL-20 if applicable) will receive second priority. Detachment G and Davis Monthan aircraft would then be retrofitted as required (i.e., 054 and/or 055 would already be retrofitted due to test period). There are a total of 40 to 44 converters in the system (24 in 12 aircraft plus spares) and only approximately 12 converters will be required to start and proceed with an efficient and timely turnaround. Unless timing/scheduling requires the modification to be accomplished at LAC, Burbank, the converter modifications will be performed at the ARO, Buffalo, facility (1 week turnaround time for a maximum of 5 to 10 converters per lot) with routing through LAC for functional check. This will, in addition to providing the required modification, accomplish a complete IRAN/overhaul of the converters and the program will then be starting out again with re-certified converters as if "from scratch." With the past-year to two years of overly frequent converter installation removal, handling this is indeed considered timely and prudent.

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e. The first converters will be ready for installation for flight test on 21 or 22 April 1969. One or two additional converters will be modified, upon return to ARO, in a one-week turnaround period. Because of the unanimous confidence in the new design, laying in of parts for complete fleet retrofit will proceed after the initial flight-test period of approximately five flights.

4. In addition to the above specific recommendations, conclusions and agreements, the following LOX-related subjects were discussed as indicated.

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a. [] stated that it would be desirable, in his view, to alter servicing procedures for the LOX system. Present procedures, established in the overall attempt to overcome previous LOX problems, require the LOX systems to be serviced (filled) a minimum of 1 hour and maximum of 24 hours prior to flight. At times, this presents what appears to be an unnecessary hardship when an aircraft with freshly serviced LOX systems is canceled for flight on one day and rescheduled the next; but beyond the 24 hour maximum limit on LOX servicing. An absolute minimum quantity limitation for takeoff was suggested as a possible suitable alternative. [] stated that absolutely no servicing procedure changes could be tolerated while the new system was undergoing flight test and for an undetermined period of successful operational use necessary to build confidence. Therefore, the subject of servicing procedures would be discussed at some future, unspecified date.

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b. LOX quantity gage, abnormal behavior was discussed briefly. The inconsistencies noticed in flight and/or on the ground seem to be related to the source of aircraft electrical power at a given time. Upon transition to and/or between normal, emergency and ground power the LOX quantity gage readings are altered in an unpredictable fashion. LAC is presently performing in-flight and bench testing to determine the cause for such unexpected behavior.

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c. Even versus uneven feeding from and between the two oxygen systems in the aircraft was discussed briefly. Two factors are apparently involved in determining if both systems will feed evenly or if one system will be predominant. The two factors are LOX system operating pressure (the breathing regulator with the lowest inlet pressure will tend to feed more than one with a higher inlet pressure) and the actual diaphragm/spring tension relationship of the breathing regulators. While great differences in the latter factor between the two regulators in a given suit are not frequently encountered, such a finding would not constitute a dangerous or even an undesirable situation. While it is generally believed that reasonably even feeding between system #1 and #2 will be the rule with the new design converters installed (since both will operate at 80 ± 2 psi), the pilot should not be concerned to see one system dominate on occasion. Normal preflight procedures are designed to confirm, for the pilot's benefit, that both systems are functioning normally and independently prior to cockpit insertion and again at the time of take-off. Once confidence in the new design is established, this possible occurrence should become insignificant.

5. In spite of an already lengthy discussion, the following opinions of the undersigned are presented for the record as guidance in the event that future life-support-related problems should arise.

a. The meeting described in previous paragraphs was the most fruitful of the long series on the subject because the prime and sub-contractors (LAC and ARO respectively) got back together, recognized each others' expertise, ironed out their differences and eliminated the "pride-of-product" factor PRIOR TO presenting recommendations to the customer. Too frequently, especially when the customer applies pressure to get a problem solved, the principles involved arbitrarily assign blame rather than looking-for-true causes and best solutions. Evidence of this is apparent in the message/memo record on the subject. Rather than dwell on this record, the principles

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involved should strive to prevent reoccurrences of over-reacting, "scape-goating", and name calling. An equal amount of effort applied to solving the true problem would yield faster and more satisfactory results.

b. The testing performed and data compiled on both the LAC RQ-1020-100 and ARO PM-24500-3 are the most definitive and comprehensive on a specifically designed LOX system the undersigned has ever seen, and the data should prove to be extremely valuable throughout the life of the system. [REDACTED] of LAC has done a fine job of planning, performing, and recording these tests. While not included here, ARO contributed (to LAC) an equally comprehensive package on their system. Both contractors have turned out professional and useful information in this latest effort, thus restoring the confidence of the undersigned in their respective abilities.

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